REMARKS/ARGUMENTS

Claim 1 has been amended. Claim 5 has been canceled. New Claims 15-26 have been added. Support for the amendments and the new claims can be found throughout the Specification. No new matter has been added.

In the February 3, 2010 Office Action, the Examiner made final the previous restriction requirement. In response, Applicants accept the withdrawal of non-elected Claims 10-14 reserving the right to pursue the withdrawn claims in one or more divisional applications.

Thus, Claims 1-4, 6-9, and 15-26 are now pending.

Reconsideration of the application in view of the above amendments and the following remarks is respectfully requested.

Nonstatutory Double Patenting Rejection based on Co-pending Application No. 12/161,235

The Examiner provisionally rejected Claims 1-2 and 5 on the ground of nonstatutory obviousness-type double patenting as being unpatentable over Claims 1-12 of co-pending Application No. 12/161,235 (the "co-pending Application"). Applicants note that Claim 5 has been cancelled. This renders moot the Examiner's provisional obviousness-type double patenting rejection of Claim 5 based on the co-pending Application. Applicants respectfully submit that amended independent Claim 1 and Claim 2 are not unpatentable over Claims 1-12 of the co-pending Application for the reasons set out below.

Applicants' submissions in this respect have been prepared in light of the standard established by the Courts and set forth in the M.P.E.P. § 804. "Since the analysis employed in an obviousness-type double patenting determination parallels the guidelines for a 35 U.S.C. 103(a) rejection, the factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103 are employed when making an obvious-type double patenting analysis." The factual inquiries are summarized as follows:

> (A) Determine the scope and content of a patent claim relative to a claim in the application at issue;
>
> (B) Determine the differences between the scope and content of the

patent claim as determined in (A) and the claim in the application at issue;

(C) Determine the level of ordinary skill in the pertinent art; and

(D) Evaluate any objective indicia of nonobviousness.

The conclusion of obviousness-type double patenting is made in light of these factual determinations.

The double patenting analysis must rely on a comparison of the claims as set forth in the M.P.E.P. § 804. "One significant difference is that a double patenting rejection must rely on a comparison with the claims in an issued or to be issued patent, whereas an anticipation or obviousness rejection based on the same patent under 35 U.S.C. 102(e)/103(a) relies on a comparison with what is disclosed (whether or not claimed) in the same issued or to be issued patent." [emphasis added]

With respect to factual inquiry (B), Applicants submit that important differences exist between the scope and content of amended Claim 1 and Claim 2 of the present application and Claims 1-12 of the co-pending Application.

In this regard, amended Claim 1 recites: A boronic acid substituted polyaniline polymer capable of converting between a self-doped form and a non-self doped form by a reversible chemical reaction wherein the reversible chemical reaction comprises complexation between boronic acid of the polyaniline polymer with a saccharide in the presence of fluoride. Claim 2 recites: The polymer according to claim 1 having a hardness of at least 0.03 GPa.

Claim 1 of the co-pending Application recites: A method for producing a polymer comprising: reacting a fluoride and a monomer having a boronic acid moiety, or a salt thereof, in an acidic aqueous solution or in an aliphatic alcohol; and polymerizing using an oxidizing agent. Claim 12 of the co-pending Application recites: A polymer produced by the method of claim 1.

Applicants submit that none of Claims 1-12 of the co-pending Application includes a reference to a saccharide. Accordingly, none of Claims 1-12 of the co-pending Application recites a reversible chemical reaction comprising complexation between boronic acid of the polyaniline polymer with a saccharide in the presence of fluoride as recited in amended Claim 1.

Applicants submit that the polyaniline polymer of amended Claim 1 and Claim 2 is patentably distinct from the subject matter of Claims 1-12 of the co-pending Application because of these differences. Applicants further submit that none of the other factual inquiries of the double patenting analysis detracts from this finding. Accordingly, withdrawal of the rejection of Claims 1-2 based on Claims 1-12 of the co-pending Application is respectfully requested.

Rejection Under 35 U.S.C. § 102(b) based on Shoji et al.

The Examiner rejected Claims 1-2 and 5-7 as being anticipated by Shoji et al. (JACS 2002, 124, 12486-12493). Applicants note that Claim 5 has been canceled. This renders moot the Examiner's rejection of Claim 5 based on Shoji et al. Applicants respectfully submit that amended independent Claim 1 and independent Claim 6 are not anticipated by Shoji et al. for the reasons set out below.

The standard for an anticipation rejection under 35 U.S.C. §102 has been well established by the Court of Appeals for the Federal Circuit, and is summarized in M.P.E.P. § 2131. "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). ... "The identical invention must be shown in as complete detail as is contained in the ... claim." *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989). The elements must be arranged as required by the claim, but this is not an *ipsissimis verbis* test, i.e., identity of terminology is not required. *In re Bond*, 910 F.2d 831, 15 USPQ2d 1566 (Fed. Cir. 1990). ...

Amended Claim 1 recites: A boronic acid substituted polyaniline polymer capable of converting between a self-doped form and a non-self doped form by a reversible chemical reaction wherein the reversible chemical reaction comprises complexation between boronic acid of the polyaniline polymer with a saccharide in the presence of fluoride.

On page 4 of the Office Action, the Examiner stated as follows:

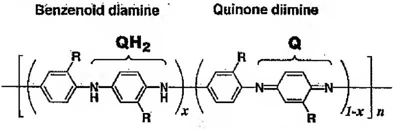
> ...Shoji et al. discloses a poly(3-aminophenylboronic acid) capable of converting between a water-soluble self-doped form and a water-insoluble non-self doped from [sic] by a reversible chemical reaction by exposing poly(3-aminophenylboronic acid) in D-fructose in PBS based on the

following schemes (Pg. 12487, Experimental Section, 12488, col. 1, 12489, Fig. 2):

Scheme 1

, and

Scheme 2



1 R: -H **2 R: -B(OH)$_2$**

Applicants respectfully submit that Shoji et al. does not disclose each and every element as set forth in amended Claim 1 because the poly(aniline boronic acid) of Shoji et al. does not involve complexation between boronic acid of the polyaniline polymer with a saccharide in the presence of fluoride as recited in amended Claim 1. In contrast to the polyaniline polymer of amended Claim 1, Shoji et al. discloses a poly(aniline boronic acid) that is complexed with a saccharide in the presence of phosphate buffer saline (PBS) solution in the absence of fluoride.

For example, Shoji et al. recites as follows on page 12487 (column 1) with reference to Scheme 1 (shown above):

> The complexation of saccharides (as well as alkyl and aromatic diols) with aromatic boronic acids produces a stable boronate anion[12] and a proton (1:1 stoichiometry) in the pH range 6−10 (see Scheme 1).

Applicants respectfully submit that neither Scheme 1 nor the description of Scheme 1 in Shoji et al. includes fluoride.

Furthermore, Applicants submit that neither Figure 2 nor the description of Figure 2 in Shoji et al. includes a reference to fluoride. In contrast, Figure 2 is described as follows on page 12489 (column 2) of Shoji et al.:

> ***Figure 2.*** (A) Response curve of a poly(anilineboronic acid) electrode as a function of time upon addition of 6.8 mM: (a) α-Methyl-D-glucoside; (b) D-glucose; (c) D-fructose in pH 7.4 PBS. (B) Response of poly-(vinylphenylboronic acid) coated polyaniline upon two additions of 3.4 mM D-fructose in pH 7.4 PBS. [emphasis added]

In addition, Applicants submit that the representation of polyaniline 1 consisting of benzenoid diamine and quinone diimine groups in Scheme 2 of Shoji et al. (shown above) does not include reference to fluoride. In contrast to the present application, Shoji et al. recites as follows on pages 12488 (column 2)-12489 (column 1) with reference to Scheme 2:

> **Open-Circuit Potential Measurements.** Polyaniline **1** (see Scheme 2) consists of benzenoid diamine and quinone diimine groups.[53-55] The distribution of these groups is a function of the oxidation state of the polymer and the degree of protonation of the polymer is a function of the pH (the pK_a of protonated amine and imine are 2.5 and 5.5, respectively).[56,57] Since the redox chemistry of **1** involves both electron and proton-transfer processes, the electrochemical potential is sensitive to changes in pH. More precisely, the dependence of the electrochemical potential on pH can be described by a double-square scheme.[58]

Applicants submit that the description of Scheme 2 in Shoji et al. also does not include reference to fluoride.

In contrast to the present application, Shoji et al. discloses use of fluoride only during the electrochemical polymerization of poly(aniline boronic acid) and not during analyte detection which involves complexation of the boronic acid group of the poly(aniline boronic acid) with the saccharide. Furthermore, Shoji et al. fails to disclose use of a saccharide during the electrochemical polymerization of poly(aniline boronic acid).

For example, Shoji et al. recites as follows with reference to the electrochemical polymerization of poly(aniline boronic acid) on page 12488 (column 1):

> **Electrochemical Production of PABA.** PABA was produced electrochemically on a glassy carbon electrode.[50] The reaction procedure and conditions were as follows: 3-aminophenylboronic acid hydrochloride salt (87 mg, 40 mM) and sodium fluoride (21 mg, 40 mM) were dissolved in 0.2 M HCl solution 12.5 mL. Nafion solution (2 mL) was added and the solution mixture was vigorously stirred. The potential was scanned between 0.0 and +1.1 V in the unstirred solution until the charge in the cathodic scan reached 10 mC cm^{-2}. The deep bluish-green film that was obtained was washed with water and placed in a 0.1 M HCl solution to verify its redox behavior with CV. The potential window for CV measurement was 0.0−0.8 V. After verifying that the redox response was stable, the potential was scanned to +0.8 V and held at that potential for 10 s. The electrode was then rinsed with water, followed with PBS solution, and then soaked in PBS solution for 24 h to allow the electrochemical potential to stabilize. At this point, the polymer film was a deep blue color. PABA produced in the presence of higher sodium fluoride concentrations (105 mg, 200 mM) was prepared in an identical fashion with the exception of the absence of Nafion and the use of 0.5 M HCl.

Applicants submit that the "Experimental Section" of Shoji et al. fails to disclose the use of a saccharide during the polymerization of poly(aniline boronic acid).

Similarly, for example, Figure 1 of Shoji et al., which is described as follows on page 12488 (column 2):

> ***Figure 1.*** Cyclic voltammogram of a GC electrode in (a) 0.5 M HCl blank, (b) 40 mM phenylboronic acid plus 200 mM NaF in 0.5 M HCl, and (c) 40 mM aminophenylboronic acid plus 200 mM NaF in 0.5 M HCl and (d) subsequent scans of (c). Scan rate: 100 mV s^{-1}.

fails to disclose use of a saccharide during polymerization of poly(aniline boronic acid). The polymerization of poly(aniline boronic acid) is further described with reference to Figure 1 as follows on page 12488 (column 2) of Shoji et al.:

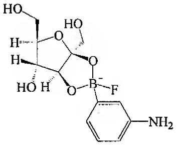
> **Production of PABA.** The impact of fluoride complexation with aromatic boronic acids is illustrated by the significant increase in the solubility of phenylboroninc acid in both neutral and acidic solutions upon the addition of fluoride. The increase in solubility is a result of the formation of the fluorinated boronate anion.[51] Figure 1a and b demonstrate that the fluorinated boronate anion species is electrochemically inert within the potential window between −0.2 and +1.1 V. In contrast, 3-aminophenylboronic acid is readily oxidized in the presence of fluoride at approximately +1.0 V (see Figure 1c). Continued cycling of the potential results in the growth of PABA on the electrode surface in agreement with previous reports.[50]

and also fails to disclose use of a saccharide during polymerization of poly(aniline boronic acid).

Accordingly, Applicants submit that Shoji et al. does not disclose the complexation of boronic acid of the polyaniline polymer with a saccharide in the presence of fluoride as recited in amended Claim 1.

In view of the foregoing, Applicants submit that amended Claim 1 is not anticipated by Shoji et al. and request withdrawal of the rejection of Claim 1 based on Shoji et al. Claim 2 depends directly on amended Claim 1. Accordingly, withdrawal of the rejection of Claim 2 based on Shoji et al. is respectfully requested.

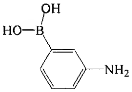
Claim 6 recites: A self-doped polyaniline capable of converting between: a water-soluble self-doped form comprising repeating units as shown below



2

; and

a water-insoluble non-self-doped form comprising repeating units as shown below:



1

wherein the water-soluble form is converted to the water-insoluble form by reducing fluoride concentration of the polymer.

On page 4 of the Office Action, the Examiner further stated that "[t]he resultant polymer [of Shoji et al.] meets the structures of claim 6." Applicants respectfully disagree with the Examiner's interpretation and submit that Shoji et al. does not teach or suggest a self-doped polyaniline comprising the repeating units recited in Claim 6.

As discussed above, Applicants submit that neither Scheme 1 nor the description of Scheme 1 in Shoji et al. includes fluoride. Neither Figure 2 nor the description of Figure 2 in Shoji et al. includes a reference to fluoride. Furthermore, neither Scheme 2 nor the description of Scheme 2 in Shoji et al. includes a reference to fluoride. Also, as discussed above, Applicants submit that Shoji et al. discloses use of fluoride only during the electrochemical polymerization of poly(aniline boronic acid) and not during analyte detection of the saccharide. Furthermore, Shoji et al. fails to teach or suggest the use of a saccharide during electrochemical polymerization of poly(aniline boronic acid). Accordingly, Applicants submit that Shoji et al. does not teach or suggest a self-doped polyaniline comprising the repeating units recited in Claim 6.

In addition, Applicants respectfully disagree with the Examiner's interpretation that "Shoji et al. discloses a poly(3-aminophenylboronic acid) capable of converting between a water-soluble self-doped form and a water-insoluble non-self doped from [sic] by a reversible chemical reaction..." [emphasis added] Applicants submit that Shoji et al. discloses the use of poly(aniline boronic acid) as a sensor for detecting saccharides in aqueous solutions (for example, PBS). Based on the teachings of Shoji et al., the person of ordinary skill would be led to appreciate that it would be undesirable to use a polymer that becomes water-soluble upon complexation with an analyte as a sensor for detecting that analyte in an aqueous sample. Accordingly, Applicants submit that Shoji et al. fails to teach or suggest "a self-doped polyaniline capable of converting between a water-soluble self-doped form . . . and a water-

<u>insoluble</u> non-self-doped form" as recited in Claim 6.

In view of the foregoing, Applicants submit that Claim 6 is not anticipated by Shoji et al. and request withdrawal of the rejection of Claim 6 based on Shoji et al. Claim 7 depends directly on Claim 6. Accordingly, withdrawal of the rejection of Claim 7 based on Shoji et al. is respectfully requested.

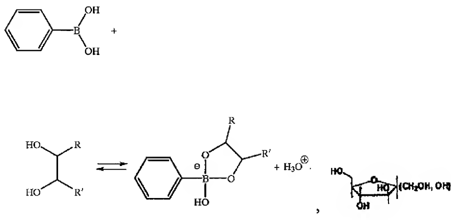
<u>Rejection Under 35 U.S.C. § 102(b) based on Freund et al.</u>

The Examiner rejected Claims 1-2 and 5-7 as being anticipated by Freund et al. (US 2002/0029979). Applicants note that Claim 5 has been canceled. This renders moot the Examiner's rejection of Claim 5 based on Freund et al. Applicants respectfully submit that amended independent Claim 1 and independent Claim 6 are not anticipated by Freund et al. for the reasons set out below.

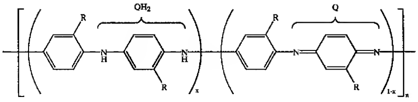
Amended Claim 1 recites: A boronic acid substituted polyaniline polymer capable of converting between a self-doped form and a non-self doped form by a reversible chemical reaction wherein the reversible chemical reaction comprises complexation between boronic acid of the polyaniline polymer with a saccharide in the presence of fluoride.

On pages 4-5 of the Office Action, the Examiner stated as follows:

> ...Freund et al. discloses a poly(3-aminophenylboronic acid) capable of converting between a water-soluble self-doped form and a water-insoluble non-self doped from [sic] by a reversible chemical reaction by exposing poly(3-aminophenylboronic acid) in D-fructose in PBS based on the following schemes (0029-31, 0046-48, Fig. 2):



, and

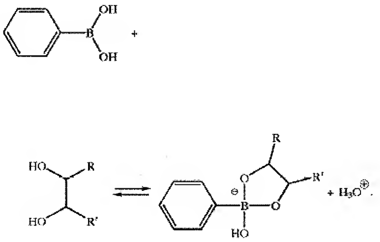


1 R=H 2 R=B(OH)₂

Applicants submit that Freund et al. does not disclose each and every element as set forth in amended Claim 1 because the poly(aniline boronic acid) of Freund et al. does not involve complexation between boronic acid of the polyaniline polymer with a saccharide in the presence of fluoride as recited in amended Claim 1. In contrast to the polyaniline polymer of amended Claim 1, Freund et al. discloses a poly(aniline boronic acid) that is complexed with a saccharide in phosphate buffer saline (PBS) solution in the absence of fluoride.

For example, Scheme 1 of Freund et al. is reproduced below:

Scheme 1

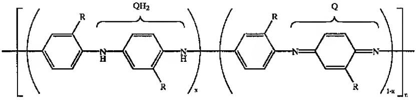


Freund et al. recites as follows in [0029] with reference to Scheme 1:

> [0029] Thus, for example, one embodiment of a sensor system 100 provides a non-enzymatic glucose sensor based on the reversible complexation reaction between boronic acid and diols, illustrated in Scheme 1, below.

Applicants submit that neither Scheme 1 nor the description of Scheme 1 in Freund et al. includes fluoride.

Furthermore, Applicants submit that the representation of poly(aniline) 1 and 2 consisting of benzenoid diamine and quinone diimine groups of Freund et al. (reproduced below) does not include reference to fluoride.



1 R=H 2 R=B(OH)2

In contrast to the present application, Freund et al. recites as follows in paragraphs [0030]-[0031] with reference to the above representation of poly(aniline) 1 and 2:

> **[0030]** Poly(aniline) 1 consists of benzenoid diamine and quinone diimine groups, where the distribution of these groups is a function of the oxidation state of the polymer, and the degree of protonation of the polymer is a function of the pH.
>
> **[0031]** Since the redox chemistry of 1 involves both electrons and protons, the open circuit voltage, E_{oc}, is sensitive to changes in pH. Likewise, it can be shown that the E_{oc}, will be a function of K_a. For example, the acid-base reaction associated with the quinone diimine group in 1 can be written as:
>
> $$Q+2H^+ \rightleftharpoons QH_2^{2+} \qquad (1)$$

Accordingly, Applicants submit that the description of the representation of poly(aniline)1 and 2 in Freund et al. also does not include reference to fluoride.

Applicants submit that paragraphs [0046]-[0048] of Freund et al. also do not disclose the complexation between boronic acid of the polyaniline polymer with a saccharide in the presence of fluoride as recited in amended Claim 1. In contrast to the present application, Freund et al. discloses use of fluoride only during the electrochemical polymerization of poly(aniline boronic acid) and not during analyte detection which involves complexation of the boronic acid group of the poly(aniline boronic acid) with the saccharide. In fact, paragraph [0046] of Freund et al. discloses that fluoride was removed from the poly(aniline boronic acid) after polymerization and before complexation with the saccharide. For example, paragraph [0046] of Freund et al. recites as follows:

> [0046] The oxidative polymerization of 3-aminophenylboronic acid was performed producing poly(aniline-3-boronic acid) (PABA) as follows: 3-aminophenylboronic acid (40 mM) and sodium fluoride (40 mM) were dissolved in 25 mL sulfuric acid aqueous solution (0.5 M) containing 5 mM Nafion (commercially available 40 wt % Nafion alcohol-water mixture solution was used). The potential of the GC electrode was scanned between 0.0 and 1.1 V vs. SCE at a scan rate of 100 mV/s. Polymerization was halted when the charge passed for the reduction of the deposited polymer reached 0.34 mC. The production of the PABA layer had a deep greenish blue color similar to that obtained upon the formation of poly(aniline). X-ray photoelectron spectra of 2 showed that after equilibrating in PBS, <u>all fluoride was exchanged out of the film.</u> After careful washing of the layer with pure water, the electrode was stored in pH 7.4 PBS buffer to settle its chemical potential [emphasis added]

Furthermore, Freund et al. fails to disclose use of a saccharide during the electrochemical polymerization of poly(aniline boronic acid).

Applicants submit that FIG. 2 of Freund et al. does not include a reference to fluoride. In contrast, FIG. 2 is described as follows in paragraph [0013] of Freund et al.:

> [0013] **FIG. 2** is a response curve of <u>a poly(aniline boronic acid) electrode</u> as a function of time upon addition of 6.8 mM: a) α-Methyl-D-glucoside; b) D-glucose; and <u>c) fructose in pH 7.4 PBS.</u> [emphasis added]

FIG. 2 is further described in paragraphs [0049]-[0050] of Freund et al. as follows:

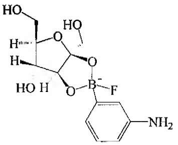
> [0049] Due to the sensitivity of 1 to pH, it is expected that the E_{oc} will be sensitive to the local pH drop within the film associated with the formation of the complex (Scheme 1). This was confirmed by observing increases in E_{oc} for 1 coated with poly(vinylphenylboronic acid) upon the addition of glucose. However, as expected, the responses associated with local pH changes were transient in nature due to the rapid return to equilibrium with the bulk solution. Similar transient increases in E_{oc} are observed as spikes in **FIG. 2** upon the addition of different sugars.
>
> [0050] The slower steady-state responses that are observed in **FIG. 2** are consistent with a change in pK_a of 1 and subsequent protonation. It should be noted that the positive change in E_{oc} is in contrast to the change in redox behavior expected for the inductive effect on an isolated redox center that does not involve the transfer of protons. For example, according to the results obtained with the boronic acid substituted ferrocene/ferrocenium redox couple, reported by A. Moore et al., *Can. J. Chem.* 1999, 77, 681-686, the apparent formal potential decreases upon formation of the electron donating boronate anion structure.

and also does not include reference to fluoride.

Accordingly, Freund et al. fails to disclose the complexation between boronic acid of the polyaniline polymer with a saccharide in the presence of fluoride as recited in amended Claim 1.

In view of the foregoing, Applicants submit that amended Claim 1 is not anticipated by Freund et al. and request withdrawal of the rejection of Claim 1 based on Freund et al. Claim 2 depends directly on amended Claim 1. Accordingly, withdrawal of the rejection of Claim 2 based on Freund et al. is respectfully requested.

Claim 6 recites: A self-doped polyaniline capable of converting between: a water-soluble self-doped form comprising repeating units as shown below



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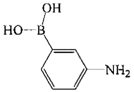
; and

a water-insoluble non-self-doped form comprising repeating units as shown below:



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wherein the water-soluble form is converted to the water-insoluble form by reducing fluoride concentration of the polymer.

On page 5 of the Office Action, the Examiner further stated that "[t]he resultant polymer [of Freund et al.] meets the structures of claim 6." Applicants respectfully disagree with the Examiner's interpretation and submit that Freund et al. does not disclose a self-doped polyaniline comprising the repeating units recited in Claim 6.

As discussed above, Applicants submit that neither Scheme 1 nor the description of Scheme 1 in Freund et al. includes fluoride. Neither the representation of poly(aniline) 1 and 2 nor the description of this representation in Freund et al. includes fluoride. Furthermore, neither FIG. 2 nor the description of FIG. 2 in Freund et al. includes a reference to fluoride. Also, as discussed above, Applicants submit that Freund et al. discloses use of fluoride only during the electrochemical polymerization of poly(aniline boronic acid) and not during analyte detection of the saccharide. Furthermore, Freund et al. fails to teach or suggest the use of a saccharide during electrochemical polymerization of poly(aniline boronic acid). Accordingly, Applicants submit that Freund et al. does not teach or suggest a self-doped polyaniline comprising the repeating units recited in Claim 6.

In addition, Applicants respectfully disagree with the Examiner's interpretation that "Freund et al. discloses a poly(3-aminophenylboronic acid) capable of converting between a water-soluble self-doped form and a water-insoluble non-self doped from [sic] by a reversible chemical reaction..." [emphasis added] Applicants submit that Freund et al. discloses the use of poly(aniline boronic acid) as a sensor for detecting saccharides in aqueous solutions (for example, PBS). Based on the teachings of Freund et al., the person of ordinary skill would be led

to appreciate that it would be undesirable to use a polymer that becomes water-soluble upon complexation with an analyte as a sensor for detecting that analyte in an aqueous sample. Accordingly, Applicants submit that Freund et al. fails to teach or suggest "a self-doped polyaniline capable of converting between a water-soluble self-doped form . . . and a water-insoluble non-self-doped form" as recited in Claim 6.

In view of the foregoing, Applicants submit that Claim 6 is not anticipated by Freund et al. and request withdrawal of the rejection of Claim 6 based on Freund et al. Claim 7 depends directly on Claim 6. Accordingly, withdrawal of the rejection of Claim 7 based on Freund et al. is respectfully requested.

Rejection Under 35 U.S.C. § 103(a) based on Shoji et al. in view of Mattoso et al.

The Examiner rejected Claims 3-4 and 8-9 as being unpatentable over Shoji et al. (JACS 2002, 124, 12486-12493) in view of Mattoso et al. (Synthetic Metals, 68 (1994), 1-11). Applicants respectfully submit that Claims 3-4 and 8-9 are not unpatentable over Shoji et al. in view of Mattoso et al. for the reasons set out below.

Applicants submit that the Shoji et al. and Mattoso et al. references fail to satisfy the requirements for a finding of obviousness of amended independent Claim 1 and independent Claim 6.

Applicants' submissions in this respect have been prepared in light of the "Examination Guidelines for Determining Obviousness Under 35 U.S.C. § 103 in view of the Supreme Court Decision in *KSR International Co. v. Teleflex Inc.*" (Federal Register, Vol. 72, No. 195, Oct. 10, 2007, pp. 57526 – 57535) (the "Guidelines").

In *Graham v. John Deere Co. of Kansas City*, 383 U.S. 1 at 17-18 (1966), the Supreme Court set out the following objective framework for applying the statutory language of §103:

> Under §103, the scope and content of the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained; and the level of ordinary skill in the pertinent art resolved. Against this background the obviousness or nonobviousness of the subject matter is determined. Such secondary considerations as

> commercial success, long felt but unsolved needs, failure of others, etc., might be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented.

Accordingly, the Guidelines confirm that obviousness is a question of law based on underlying factual inquiries. The factual inquiries enunciated by the Court in *Graham* are as follows:

> (1) Determining the scope and content of the prior art;
>
> (2) Ascertaining the differences between the claimed invention and the prior art; and
>
> (3) Resolving the level of ordinary skill in the pertinent art.

With respect to the second of the *Graham* factual inquiries, Applicants submit that important differences exist between the claimed invention and the Shoji et al. and Mattoso et al. references.

In this regard, amended Claim 1 recites: A boronic acid substituted polyaniline polymer capable of converting between a self-doped form and a non-self doped form by a reversible chemical reaction wherein the reversible chemical reaction comprises complexation between boronic acid of the polyaniline polymer with a saccharide in the presence of fluoride.

As discussed above, Applicants submit that Shoji et al. does not teach or suggest the complexation between boronic acid of the polyaniline polymer with a saccharide in the presence of fluoride as recited in amended Claim 1. Furthermore, Shoji et al. does not teach or suggest the preparation of a polyaniline polymer by oxidative polymerization of monomer in the presence of fluoride and D-fructose.

On page 6 of the Office Action, the Examiner stated as follows:

> Mattoso et al. discloses increasing the MW to 64-90k of polyanilines by successive oxidation and further increasing the MW to 156k or 160k by using polyvinylsulfonic acid or ammonium peroxydisulfate for oxidative polymerization (Pg. 1, col. 1-2). Mattoso et al. teaches having high MW is highly desirable (Pg. 1, col. 1). One of ordinary

> skill in the art would obviously recognize to increase MW of a polymer for improving its film forming capability and mechanical strength.

Applicants submit that Mattoso et al. does not teach or suggest the complexation between boronic acid of the polyaniline polymer with a saccharide in the presence of fluoride as recited in amended Claim 1. Furthermore, Mattoso et al. does not teach or suggest the preparation of a polyaniline polymer by oxidative polymerization of monomer in the presence of fluoride and D-fructose. In contrast to the present application, Mattoso et al. discloses the synthesis of high molecular weight polyaniline and poly(*o*-methoxyaniline) based on such factors as the use of selected dissolved neutral metallic salts (for example, LiF, NaCl, $CaCl_2$, LiCl, $LiNO_3$), and the effects of viscosity and low temperature, with no teaching or suggestion of the use of D-fructose.

Applicants further submit that these differences between amended Claim 1 and the Shoji et al. and Mattoso et al. references are significant. In this regard, Applicants submit that it would not have been obvious to modify the polyaniline disclosed by Shoji et al. because neither Shoji et al. nor Mattoso et al. teaches or suggests the use of fluoride and D-fructose for the electrochemical polymerization of poly(aniline boronic acid). Accordingly, neither Shoji et al. nor Mattoso et al., alone or in combination, teaches or suggests a method of preparing the polyaniline polymer of amended Claim 1 and there is no reasonable expectation of success to achieve the claimed invention. To the contrary, Mattoso et al. discloses that the presence of LiF during electrochemical polymerization of polyaniline exhibited the effect of decreasing the molecular weight of the polymer produced. For example, Mattoso et al. recites as follows on page 8:

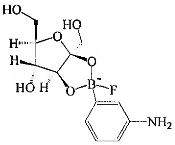
> The present study has brought to light a remarkable dependence of the molecular weight of polyaniline and of poly(*o*-methoxyaniline) during the oxidative polymerization of aniline and of methoxyaniline, respectively, at 0 to 3 °C in the presence of neutral metallic salts. The presence of LiCl, NaCl, $CaCl_2$ and $LiNO_3$ dissolved in the reaction mixture increases the molecular weight of the polymer produced, whereas dissolved LiF and dissolved agar (which increases the viscosity of the reaction solution) both decrease the molecular weight as compared to the polymer obtained when the reaction is carried out in the absence of added neutral salts.
> [emphasis added]

In fact, Mattoso et al. would lead a person of ordinary skill away from the use of fluoride during the electrochemical polymerization of polyaniline polymer.

Thus, in view of the above differences, Applicants respectfully submit that the second of the three *Graham* factual inquiries strongly supports a finding of non-obviousness of amended Claim 1. Applicants further submit that neither the first nor the third of the *Graham* factual inquiries detracts from a finding of non-obviousness in the present application.

In view of the foreoing, Applicants submit that amended Claim 1 is not unpatentable over Shoji et al. in view of Mattoso et al. Claims 3 and 4 depend directly on amended Claim 1. Accordingly, withdrawal of the rejection of Claims 3-4 based on Shoji et al. and Mattoso et al. is respectfully requested.

Claim 6 recites: A self-doped polyaniline capable of converting between: a water-soluble self-doped form comprising repeating units as shown below



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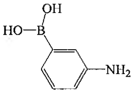
; and

a water-insoluble non-self-doped form comprising repeating units as shown below:



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wherein the water-soluble form is converted to the water-insoluble form by reducing fluoride concentration of the polymer.

As discussed above, Applicants submit that Shoji et al. does not teach or suggest "a self-doped polyaniline capable of converting between: a water-soluble self-doped form . . . and a water-insoluble non-self-doped from" as recited in Claim 6. Shoji et al. also does not teach or suggest a self-doped polyaniline capable of converting between a water-soluble self-doped form comprising repeating units 2 and a water-insoluble non-self-doped form comprising repeating units 1 as recited in Claim 6. Furthermore, Shoji et al. does not teach or suggest the preparation of a polyaniline polymer by oxidative polymerization of monomer in the presence of fluoride and D-fructose.

Applicants submit that Mattoso et al. does not teach or suggest "a self-doped polyaniline capable of converting between: a water-soluble self-doped form . . . and a water-insoluble non-self-doped from" as recited in Claim 6. Mattoso et al. also does not teach or suggest a self-doped polyaniline capable of converting between a water-soluble self-doped form comprising repeating units 2 and a water-insoluble non-self-doped form comprising repeating units 1 as recited in Claim 6. As discussed above, Applicants submit that Mattoso et al. does not teach or suggest the preparation of a polyaniline polymer by oxidative polymerization of monomer in the presence of fluoride and D-fructose, and in fact, Mattoso et al. would lead a person of ordinary skill away from the use of fluoride during the electrochemical polymerization of the polyaniline polymer. Accordingly, there would be no reasonable expectation of success to achieve the claimed invention of Claim 6.

Thus, in view of the above differences, Applicants respectfully submit that the second of the three *Graham* factual inquiries strongly supports a finding of non-obviousness of Claim 6.

Applicants further submit that neither the first nor the third of the *Graham* factual inquiries detracts from a finding of non-obviousness in the present application.

In view of the foregoing, Applicants submit that Claim 6 is not unpatentable over Shoji et al. in view of Mattoso et al. Claims 8 and 9 depend directly on Claim 6. Accordingly, withdrawal of the rejection of Claims 8-9 based on Shoji et al. and Mattoso et al. is respectfully requested.

<u>Rejection Under 35 U.S.C. § 103(a) based on Freund et al. in view of Mattoso et al.</u>

The Examiner rejected Claims 3-4 and 8-9 as being unpatentable over Freund et al. (US 20020029979) in view of Mattoso et al. (Synthetic Metals, 68 (1994), 1-11). Applicants respectfully submit that Claims 3-4 and 8-9 are not unpatentable over Freund et al. in view of Mattoso et al. for the reasons set out below.

Applicants submit that the Freund et al. and Mattoso et al. references fail to satisfy the requirements for a finding of obviousness of amended independent Claim 1 and independent Claim 6.

As discussed above, the Guidelines confirm that obviousness is a question of law based on underlying factual inquiries. The factual inquiries enunciated by the Court in *Graham* are as follows:

(1) Determining the scope and content of the prior art;

(2) Ascertaining the differences between the claimed invention and the prior art; and

(3) Resolving the level of ordinary skill in the pertinent art.

With respect to the second of the *Graham* factual inquiries, Applicants submit that important differences exist between the claimed invention and the Freund et al. and Mattoso et al. references.

In this regard, amended Claim 1 recites: A boronic acid substituted polyaniline polymer capable of converting between a self-doped form and a non-self doped form by a reversible chemical reaction wherein the reversible chemical reaction comprises complexation between boronic acid of the polyaniline polymer with a saccharide in the presence of fluoride.

As discussed above, Applicants submit that Freund et al. does not teach or suggest the complexation between boronic acid of the polyaniline polymer with a saccharide in the presence of fluoride as recited in amended Claim 1. Furthermore, Freund et al. does not teach or suggest the preparation of a polyaniline polymer by oxidative polymerization of monomer in the presence of fluoride and D-fructose.

On page 7 of the Office Action, the Examiner has characterized the Mattoso et al. reference as follows:

> Mattoso et al. discloses increasing the MW to 64-90k of polyanilines by successive oxidation and further increasing the MW to 156k or 160k by using polyvinylsulfonic acid or ammonium peroxydisulfate for oxidative polymerization (Pg. 1, col. 1-2). Mattoso et al. teaches having high MW is highly desirable (Pg. 1, col. 1). One of ordinary skill in the art would obviously recognize to increase MW of a polymer for improving its film forming capability and mechanical strength.

Applicants submit that Mattoso et al. does not teach or suggest the complexation between boronic acid of the polyaniline polymer with a saccharide in the presence of fluoride as recited in amended Claim 1. Furthermore, Mattoso et al. does not teach or suggest the preparation of a polyaniline polymer by oxidative polymerization of monomer in the presence of fluoride and D-fructose. In contrast to the present application, Mattoso et al. discloses the synthesis of high molecular weight polyaniline and poly(*o*-methoxyaniline) based on such factors as the use of selected dissolved neutral metallic salts (for example, LiF, NaCl, $CaCl_2$, LiCl, $LiNO_3$), and the effects of viscosity and low temperature, with no teaching or suggestion of the use of D-fructose.

Applicants further submit that these differences between amended Claim 1 and the Freund et al. and Mattoso et al. references are significant. In this regard, Applicants submit that it would not have been obvious to modify the polyaniline disclosed by Freund et al. because neither Freund et al. nor Mattoso et al. teaches or suggests the use of fluoride and D-fructose for the electrochemical polymerization of poly(aniline boronic acid). Accordingly, neither Freund et al. nor Mattoso et al., alone or in combination, teaches or suggests a method of preparing the

polyaniline polymer of amended Claim 1 and there is no reasonable expectation of success to achieve the claimed invention. To the contrary, Mattoso et al. discloses that the presence of LiF during electrochemical polymerization of polyaniline exhibited the effect of decreasing the molecular weight of the polymer produced. For example, Mattoso et al. recites as follows on page 8:

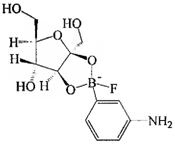
> The present study has brought to light a remarkable dependence of the molecular weight of polyaniline and of poly(o-methoxyaniline) during the oxidative polymerization of aniline and of methoxyaniline, respectively, at 0 to 3 °C in the presence of neutral metallic salts. The presence of LiCl, NaCl, $CaCl_2$ and $LiNO_3$ dissolved in the reaction mixture increases the molecular weight of the polymer produced, <u>whereas dissolved LiF and dissolved agar (which increases the viscosity of the reaction solution) both decrease the molecular weight as compared to the polymer obtained when the reaction is carried out in the absence of added neutral salts.</u>
> [emphasis added]

In fact, Mattoso et al. would lead a person of ordinary skill away from the use of fluoride during the electrochemical polymerization of polyaniline polymer.

Thus, in view of the above differences, Applicants respectfully submit that the second of the three *Graham* factual inquiries strongly supports a finding of non-obviousness of amended Claim 1. Applicants further submit that neither the first nor the third of the *Graham* factual inquiries detracts from a finding of non-obviousness in the present application.

In view of the foregoing, Applicants submit that amended Claim 1 is not unpatentable over Freund et al. in view of Mattoso et al. Claims 3 and 4 depend directly on amended Claim 1. Accordingly, withdrawal of the rejection of Claims 3-4 based on Freund et al. and Mattoso et al. is respectfully requested.

Claim 6 recites: A self-doped polyaniline capable of converting between: a water-soluble self-doped form comprising repeating units as shown below



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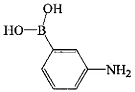
; and

a water-insoluble non-self-doped form comprising repeating units as shown below:



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wherein the water-soluble form is converted to the water-insoluble form by reducing fluoride concentration of the polymer.

As discussed above, Applicants submit that Freund et al. does not teach or suggest "a self-doped polyaniline capable of converting between: a water-soluble self-doped form . . . and a water-insoluble non-self-doped form" as recited in Claim 6. Freund et al. also does not teach or suggest a self-doped polyaniline capable of converting between a water-soluble self-doped form comprising repeating units 2 and a water-insoluble non-self-doped form comprising repeating units 1 as recited in Claim 6. Furthermore, Freund et al. does not teach or suggest the preparation of a polyaniline polymer by oxidative polymerization of monomer in the presence of fluoride and D-fructose.

Applicants submit that Mattoso et al. does not teach or suggest "a self-doped polyaniline capable of converting between: a water-soluble self-doped form . . . and a water-insoluble non-self-doped form" as recited in Claim 6. Mattoso et al. also does not teach or suggest a self-doped polyaniline capable of converting between a water-soluble self-doped form comprising repeating units 2 and a water-insoluble non-self-doped form comprising repeating units 1 as recited in Claim 6. As discussed above, Applicants submit that Mattoso et al. does not teach or suggest the

preparation of a polyaniline polymer by oxidative polymerization of monomer in the presence of fluoride and D-fructose, and in fact, Mattoso et al. would lead a person of ordinary skill away from the use of fluoride during the electrochemical polymerization of the polyaniline polymer. Accordingly, there would be no reasonable expectation of success to achieve the claimed invention of Claim 6.

Thus, in view of the above differences, Applicants respectfully submit that the second of the three *Graham* factual inquiries strongly supports a finding of non-obviousness of Claim 6. Applicants further submit that neither the first nor the third of the *Graham* factual inquiries detracts from a finding of non-obviousness in the present application.

In view of the foregoing, Applicants submit that Claim 6 is not unpatentable over Freund et al. in view of Mattoso et al. Claims 8 and 9 depend directly on Claim 6. Accordingly, withdrawal of the rejection of Claims 8-9 based on Freund et al. and Mattoso et al. is respectfully requested.

In view of the foregoing, early favorable consideration of this application is earnestly solicited.

Respectfully submitted,

DEORE, BHAVANA A. ET AL

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Date: June 2, 2010

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